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[54] **IMAGE-FORMING MACHINE EQUIPPED WITH CLEANING MEANS**

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[51] **Int. Cl.**[6] **G03G 21/00**

[52] **U.S. Cl.** **355/299**

[58] **Field of Search** 355/296, 299

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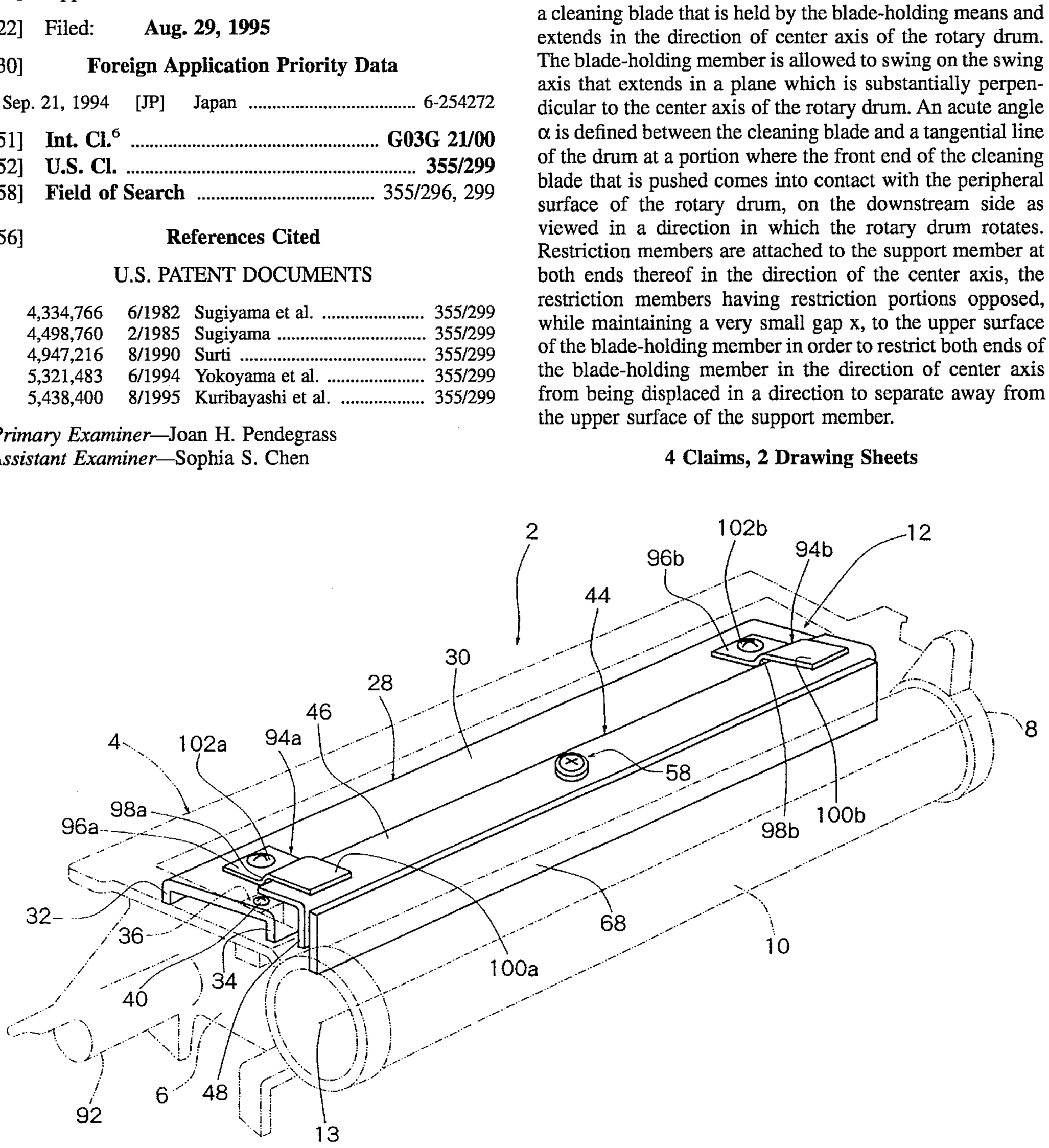
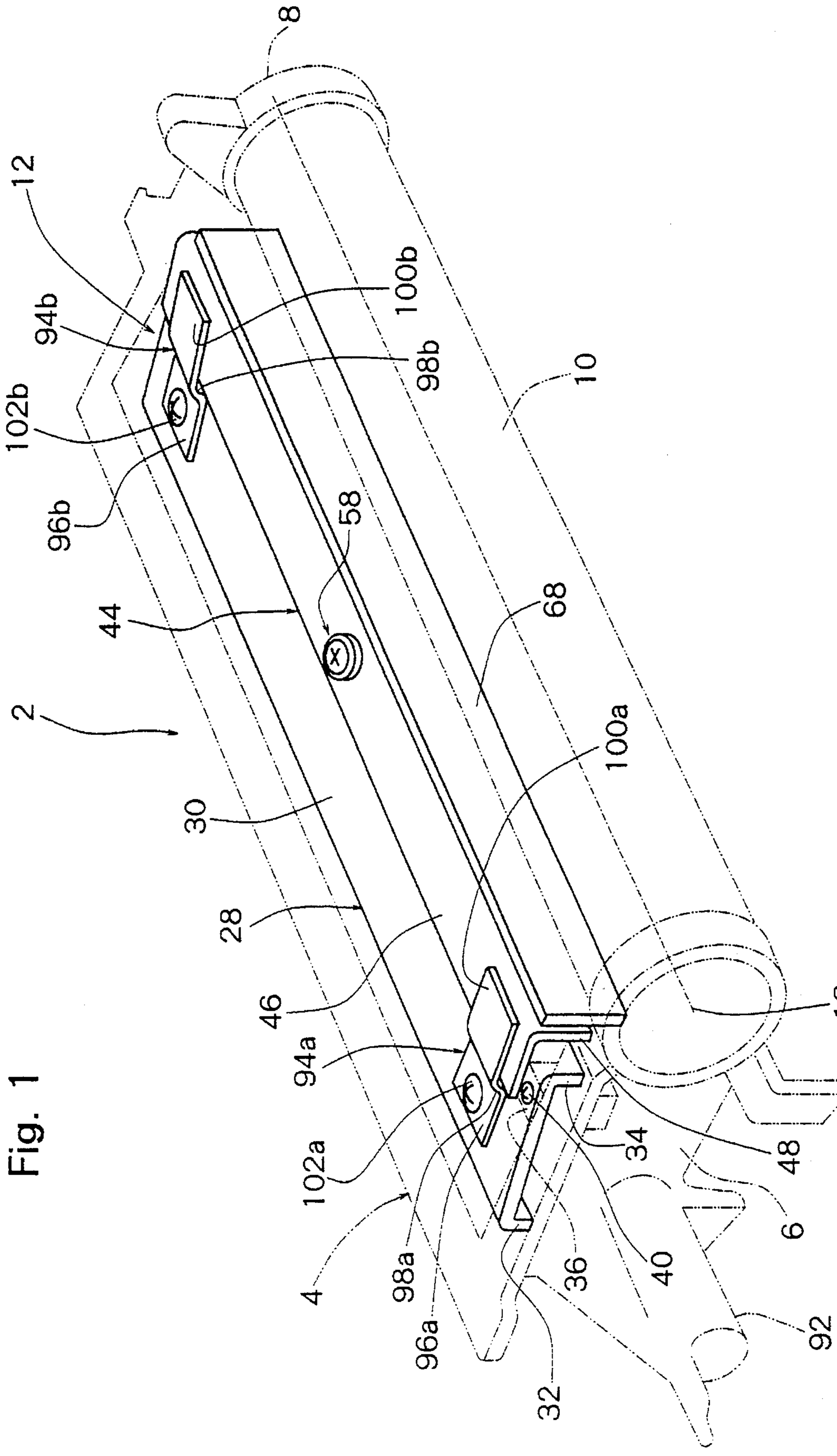
[57] **ABSTRACT**

An image-forming machine comprising a rotary drum and a cleaning means which removes the toner remaining on the peripheral surface of the rotary drum. The cleaning means includes a support member that extends in the direction of center axis of the rotary drum, a blade-holding member that is mounted on the upper surface of the support member and extends in the direction of center axis of the rotary drum, and a cleaning blade that is held by the blade-holding means and extends in the direction of center axis of the rotary drum. The blade-holding member is allowed to swing on the swing axis that extends in a plane which is substantially perpendicular to the center axis of the rotary drum. An acute angle α is defined between the cleaning blade and a tangential line of the drum at a portion where the front end of the cleaning blade that is pushed comes into contact with the peripheral surface of the rotary drum, on the downstream side as viewed in a direction in which the rotary drum rotates. Restriction members are attached to the support member at both ends thereof in the direction of the center axis, the restriction members having restriction portions opposed, while maintaining a very small gap x, to the upper surface of the blade-holding member in order to restrict both ends of the blade-holding member in the direction of center axis from being displaced in a direction to separate away from the upper surface of the support member.

4 Claims, 2 Drawing Sheets

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100b
102b
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10
96b
58
44
68
2
30
100a
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94a
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102a
34
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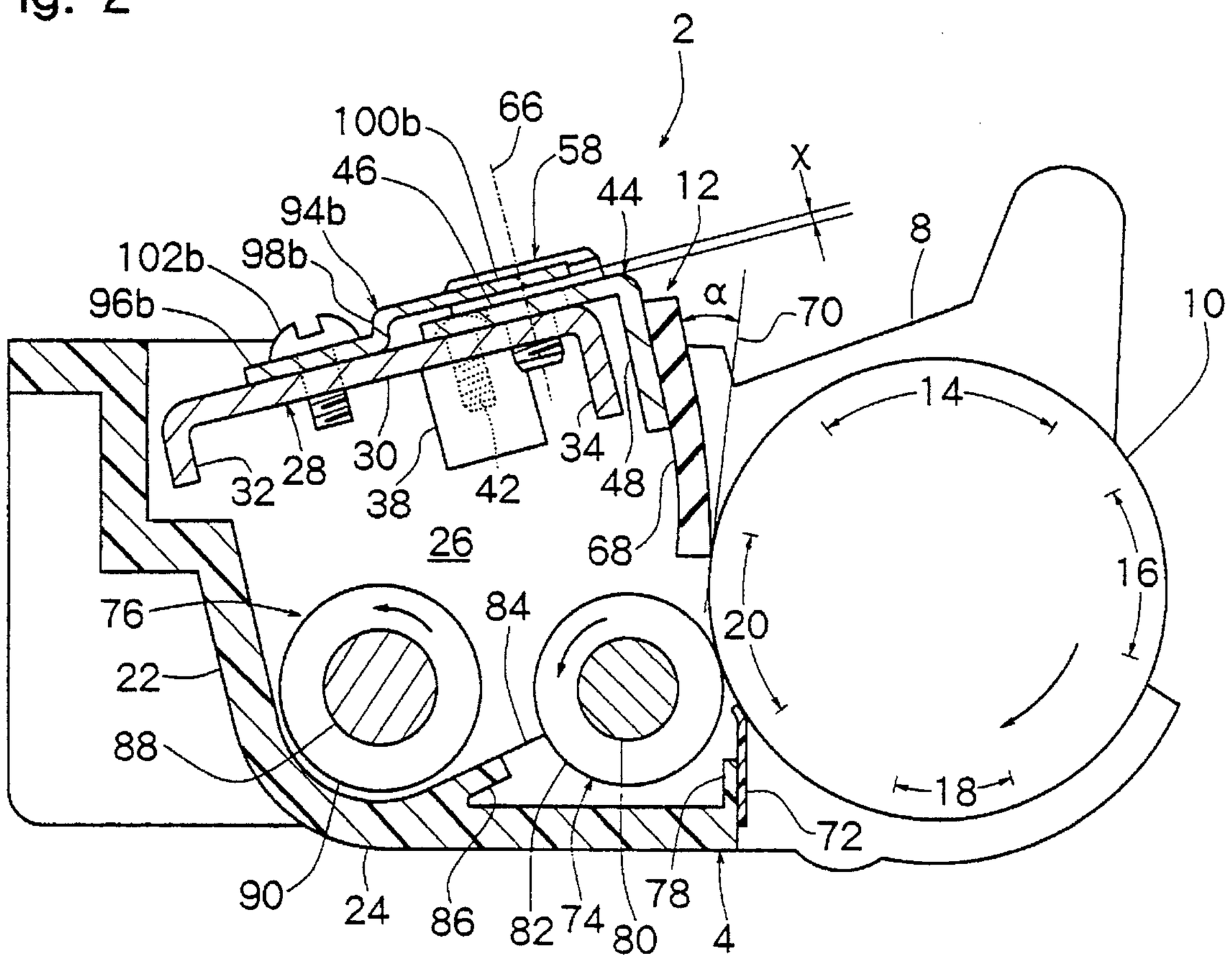
98a
36
40
96a
32
92

Fig. 1

Fig. 2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12
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102b
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70
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34
48
26
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84
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18
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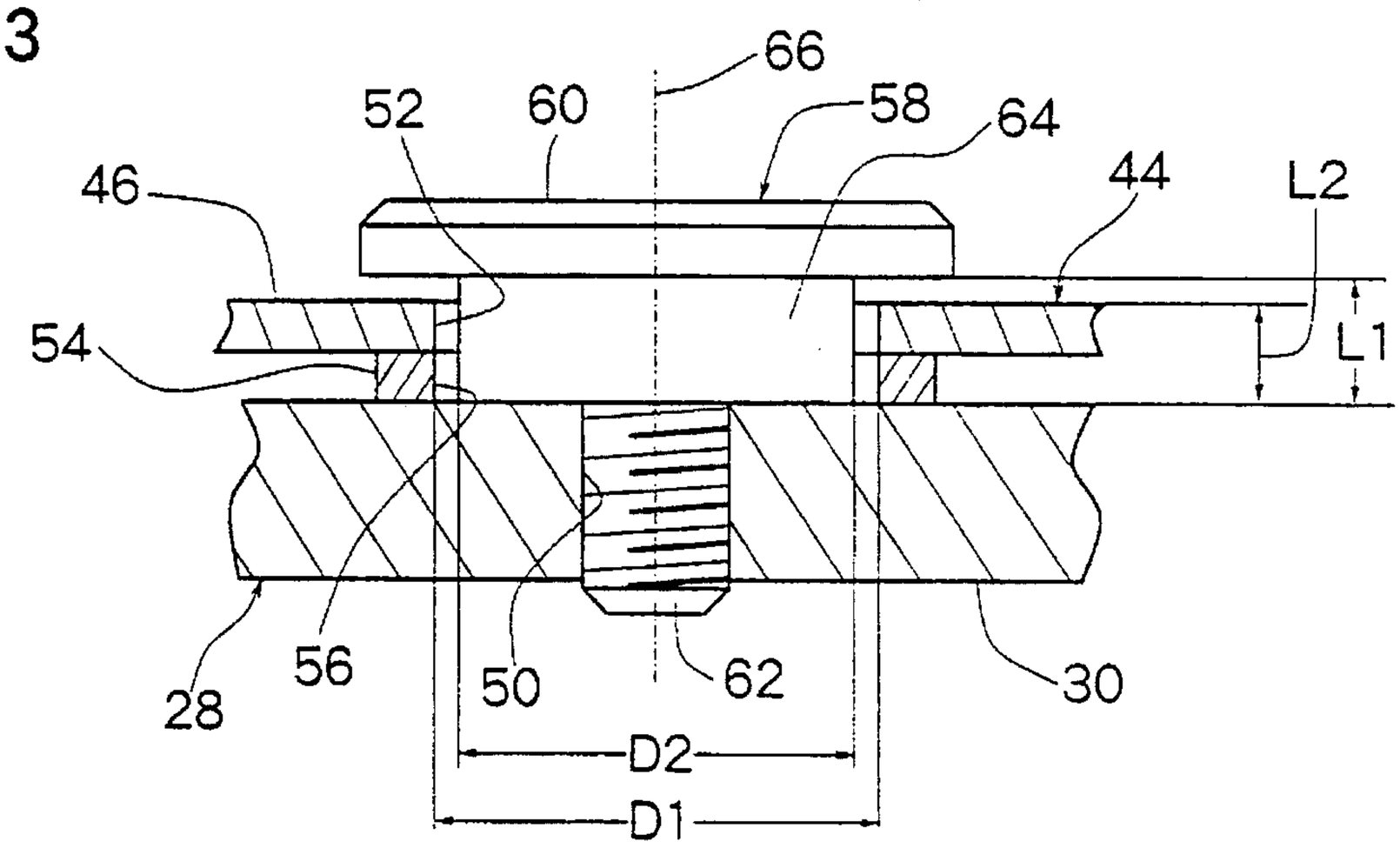
74
80
78
4

Fig. 3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L2
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L1
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D2
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IMAGE-FORMING MACHINE EQUIPPED WITH CLEANING MEANS

FIELD OF THE INVENTION

The present invention relates to an image-forming machine equipped with a cleaning means that removes toner remaining on the peripheral surface of a rotary drum. More specifically, the invention relates to an image-forming machine equipped with a cleaning means including a cleaning blade that is pushed onto the peripheral surface of the rotary drum.

DESCRIPTION OF THE PRIOR ART

An image-forming machine such as an electrostatic copying machine or an electrostatic printer is equipped with a rotary drum which has an electrostatic photosensitive material disposed on the peripheral surface thereof. The rotary drum is surrounded by an electrostatic latent image-forming zone, a developing zone, a transfer zone and a cleaning zone arranged in this order as viewed in a direction in which the rotary drum rotates. In the electrostatic latent image-forming zone, the electrostatic photosensitive material is uniformly charged and then, is selectively discharged upon the irradiation with light, so that electrostatic latent image is formed thereon. In the developing zone, the electrostatic latent image is developed into a toner image by such developing means as magnetic brush developing means. In the transfer zone, the toner image on the electrostatic photosensitive material is transferred onto a sheet material which may be a common paper. The toner image transferred onto the sheet material is fixed on the sheet member by a fixing means such as the one of the heated and pressurized type, and a copied or printed paper is obtained. In the cleaning zone, the toner remaining on the electrostatic photosensitive material is removed.

In a typical example of the cleaning means, the cleaning means comprises a support member disposed extending in the direction of center axis of the rotary drum, and a blade-support member mounted on the upper surface of the support member to extend in the direction of center axis of the rotary drum. The blade-support member is swingingly mounted at its intermediate portion in the direction of center axis of the rotary drum so as to swing on a swing axis that extends in a plane which is substantially perpendicular to the center axis of the rotary drum. On the blade support member is held a cleaning blade which is preferably made of a synthetic rubber. The cleaning blade extends in the direction of center axis of the rotary drum and its front end is pushed onto the peripheral surface of the rotary drum. The cleaning blade is disposed at a so-called counter position with respect to the rotary drum, i.e., disposed in a manner that an acute angle α is defined between a cleaning blade and a tangential line of the rotary drum at a portion where the front end of the cleaning blade comes into contact with the peripheral surface of the rotary drum, on the downstream side as viewed in a direction in which the rotary drum rotates.

In the above-mentioned cleaning means, the blade-holding member is allowed to swing on a swing axis that extends in a plane substantially perpendicularly to the center axis of the rotary drum and, hence, the cleaning blade held by the blade-holding member swings on the swing axis that extends in a plane substantially perpendicularly to the center axis of the rotary drum. It is therefore presumed that the front end of the cleaning blade extends substantially in parallel with the center axis of the rotary drum and is pushed onto the peripheral surface of the rotary drum sufficiently uniformly over the whole width of the rotary drum. However, the present inventors have found through their experience that the pushing force of the front end of the cleaning blade exerted upon the peripheral surface of the rotary drum becomes relatively small toward both ends of the rotary drum, causing the cleaning performance to become defective at both ends of the rotary drum and often causing the toner to be adhered in a form of dot or dash mark on the peripheral surface of the drum at both ends thereof.

SUMMARY OF THE INVENTION

The principal object of the present invention is to provide an improved image-forming machine in which the cleaning blade is pushed onto the peripheral surface of the rotary drum sufficiently uniformly over the whole width of the rotary drum, reliably preventing the cleaning performance from becoming poor toward both end portions of the rotary drum.

The present inventors have keenly conducted experiments and analysis concerning a conventional image-forming machine equipped with the abovementioned cleaning means, and have recognized that the cleaning performance becomes defective in the conventional image-forming machine toward both end portions of the rotary drum due to a phenomenon that is described below. That is, the cleaning blade is disposed at the counter position with respect to the rotary drum. When the rotary drum is rotated, therefore, a considerably large force is exerted on the cleaning blade from the rotary drum in a direction of separating the cleaning blade from the peripheral surface of the rotary drum. The blade-support member supporting the cleaning blade is swingingly mounted, at its intermediate portion in the direction of center axis of the rotary drum, on the support member, and extends from the intermediate portion toward its both ends in a so-called cantilevered manner. Accordingly, the blade-holding member is resiliently deformed by the considerably large force that is transmitted from the rotary drum to the blade-holding member via the cleaning blade, and both ends of the blade-holding member is displaced to a considerable degree in a direction to separate away from the upper surface of the support member. Hence, the pushing force at the front end of the cleaning blade upon the peripheral surface of the rotary drum becomes relatively small toward both ends of the rotary drum, so that the cleaning performance becomes defective.

Based upon the recognition of the above-mentioned phenomenon in the conventional imageforming machine, the above-mentioned principal object of the present invention is accomplished by attaching restriction members to the support member at both ends thereof in the direction of center axis of the rotary drum, so that restriction portions of the restriction members restrict the blade-holding member from being displaced in a direction to separate away from the upper surface of the support member at both ends in the direction of center axis of the rotary drum.

That is, according to the present invention, the above-mentioned principal object is accomplished by providing an image-forming machine comprising a rotary drum which is rotatably mounted and has an electrostatic photosensitive material disposed on the peripheral surface thereof, and a cleaning means which removes the toner remaining on the peripheral surface of the rotary drum in a cleaning zone,

said cleaning means including a support member that extends in the direction of center axis of the rotary drum, a blade-holding member that is mounted on the upper surface

of the support member and extends in the direction of center axis of the rotary drum, and a cleaning blade that is held by the blade-holding means and extends in the direction of center axis of the rotary drum,

said blade-holding member being mounted on the upper surface of the support member by coupling its intermediate portion in the direction of center axis to the upper surface of the support member to swing on the swing axis that extends in a plane which is substantially perpendicular to the center axis of the rotary drum,

the front end of the cleaning blade being pushed onto the peripheral surface of the rotary drum, and the tangential line of the rotary drum at a portion where the front end of the cleaning blade is contacted to the peripheral surface of the rotary drum and the cleaning blade defining an acute angle a on the downstream side as viewed in a direction in which the rotary drum rotates,

wherein restriction members are attached to the support member at both ends thereof in the direction of center axis, the restriction members having restriction portions opposed, while maintaining a very small gap x, to the upper surface of the blade-holding member in order to restrict both ends of the blade-holding member in the direction of center axis from being displaced in a direction to separate away from the upper surface of the support member.

It is desired that the gap x is 0.2 mm$\leqq$x $\leqq$0.4 mm. In a preferred embodiment, the blade-holding member is made of a steel plate having nearly an L-shape in cross section with a first leg and a second leg which are nearly perpendicular to each other, the first leg of the blade-holding member extends along the upper surface of the support member, the second leg of the blade-holding member protrudes from the first leg toward the rotary drum, and the cleaning blade is fastened at its base end to the second leg of the blade-holding member. It is desired that the support member is made of a steel plate having a channel shape in cross section, and the restriction members are made of a steel piece, respectively.

In the image-forming machine of the present invention, both ends of the blade-holding member are restricted by the action of the restriction members from being displaced in a direction to separate away from the upper surface of the support member. Thus, it is allowed to effectively prevent the pushing force of the front end of the cleaning blade acting upon the peripheral surface of the rotary drum from decreasing, making it possible to fully reliably prevent the cleaning performance from becoming defective. Restriction portions of the restriction members are separated away from the blade-holding member at a very small gap x until both ends of the blade-holding member are displaced to some extent in a direction to separate away from the upper surface of the support member and come into contact with the restriction portions of the restriction members. Accordingly, the blade-holding member and the cleaning blade mounted thereon are allowed to freely swing on a swing axis that extends in a plane which is substantially perpendicular to the center axis of the rotary drum and, hence, parallel relationship is inevitably compensated between the peripheral surface of the rotary drum and the front end of the cleaning blade.

In order to prevent both ends of the blade-holding member from being displaced in a direction to separate away from the upper surface of the support member, it can be contrived to form the blade-holding member using a highly rigid member such as a considerably thick steel plate. This, however, results in an increase in the cost of production and in the weight and size of the cleaning device. It can be also contrived to prevent displacement at both ends of the blade-holding member by fixing both ends of the blade-holding member to the upper surface of the support member. In this case, however, the blade-holding member is prevented from swinging on the swing axis that extends in a plane substantially perpendicular to the center axis of the rotary drum and, hence, the tolerance in the production or in the mounting is not compensated in parallel relationship between the peripheral surface of the rotary drum and the front end of the cleaning blade, and consequently, it becomes difficult to push the front end of the cleaning blade onto the peripheral surface of the rotary drum sufficiently uniformly over the whole width of the rotary drum.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view illustrating a unit equipped with a rotary drum and a cleaning means in an image-forming machine constituted according to the present invention;

FIG. **2** is a sectional view of a unit shown in FIG. **1**; and

FIG. **3** is a partial sectional view illustrating a manner of swingingly mounting a blade-holding member in the cleaning means in the unit shown in FIG. **1**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A preferred embodiment of the image-forming machine constituted according to the present invention will now be described in detail with reference to the accompanying drawings.

FIGS. **1** and **2** illustrate a unit **2** mounted on a predetermined position in a housing (not shown) of an image-forming machine. Such a unit **2** includes a unit frame **4** that is desirably made of a suitable synthetic resin as a unitary structure. The unit frame **4** has a front end wall **6** and a rear end wall **8** disposed at a predetermined distance from one another in the direction of width (direction perpendicular to the surface of the paper in FIG. **2**). A rotary drum **10** and a cleaning means **12** are disposed between the front end wall **6** and the rear end wall **8**.

The rotary drum **10** is disposed between the front end wall **6** and the rear end wall **8** of the unit frame **4** being allowed to rotate. The center axis **13** of the rotary drum **10** extends substantially horizontally. On the peripheral surface of the rotary drum **10** is disposed a suitable electrostatic photosensitive material such as an organic photosemiconductor. The rear end of a support shaft (not shown) of the rotary drum **10** protrudes rearwardly penetrating through the rear end wall **8**, and an input gear (not shown) is fitted to the rear end of the support shaft. When the unit **2** is mounted on the predetermined position in the housing, the rotary drum **10** is coupled, via the input gear, to a rotary drive source (not shown) which may be an electric motor. Being driven by the rotary drive source, the rotary drum **10** is rotated in the clockwise direction as indicated by arrow in FIG. **2**. As clearly shown in FIG. **2**, the rotary drum **10** is surrounded by an electrostatic latent image-forming zone **14**, a developing zone **16**, a transfer zone **18** and a cleaning zone **20** in this order as viewed in a direction in which the rotary drum **10** rotates. In the electrostatic latent image-forming zone **14**, the peripheral surface of the rotary drum **10** is uniformly charged to a predetermined polarity by a suitable charging means (not shown) such as a DC corona discharger. Next, the peripheral surface of the rotary drum **10** is irradiated with

light from an appropriate optical means (not shown) selectively in accordance with image that is to be formed and is discharged. Thus, electrostatic latent image is formed on the peripheral surface of the rotary drum **10**. In the developing zone **16**, the toner is applied to the peripheral surface of the rotary drum **10** by a suitable developing means (not shown) such as magnetic brush developing means, and the electrostatic latent image is developed into toner image. Then, in the transfer zone **18**, a transfer member (not shown) which may be a common paper is brought into intimate contact with the peripheral surface of the rotary drum **10**, and the toner image on the rotary drum **10** is transferred onto the transfer member. The transfer member is peeled off the rotary drum **10**, fed to a fixing means (not shown), and the toner image on the transfer member is fixed by the action of the fixing means. In the cleaning zone **20**, the toner remaining on the peripheral surface of the rotary drum **10** after the transfer operation is removed by the action of the cleaning means **12**.

With further reference to FIGS. **1** and **2**, a side wall **22** and a bottom wall **24** extending in the direction of width (in the direction perpendicularly to the surface of the paper in FIG. **2**) are disposed between the front end wall **6** and the rear end wall **8** of the unit frame **4**. The side wall **22** and the bottom wall **24** are connected to each other to define a cleaning chamber **26**. At an upper part of the cleaning chamber **26** is disposed a support member **28** extending in the direction of center axis of the rotary drum **10** (in the direction perpendicularly to the surface of the paper in FIG. **2**). It is desired that the support member **28** is made of a steel plate having a thickness of about 1.6 mm, and has a flat main portion **30** of a channel-like shape in cross section and hanging portions **32** and **34** that hang down from both side edges of the main portion **30**. A support block **36** (FIG. **1**) that rearwardly protrudes is formed at a rear upper end portion of the front end wall **6** of the unit frame **4**, and a support block **38** (FIG. **2**) that forwardly protrudes is formed at a front upper end portion of the rear end wall **8** of the unit frame **4**. The support member **28** is placed at its both ends on the support blocks **36** and **38**, and fastening screws **40** (FIG. **1**) and **42** (FIG. **2**) are screwed into the support blocks **36** and **38** passing through the holes (not shown) formed in the abovementioned both ends, so that the support member **28** is secured to the unit frame **4**. A blade-holding member **44** is mounted on the upper surface of the support member **28** extending in the direction of center axis of the rotary drum **10** (in the direction perpendicularly to the surface of the paper in FIG. **2**). It is desired that the blade-holding member **44** is made of a steel plate having a thickness of about 1.2 mm, has an L-shape in cross section, and has a first leg **46** and a second leg **48**. The first leg **46** of the blade-holding member **44** extends along the upper surface of the main portion of the support member **28**, and the second leg **48** downwardly extends toward the rotary drum **10** from one side edge (right side edge in FIG. **2**) of the first leg **46**. The size in the direction of width of the blade support member **44** (size in the direction of center axis of the rotary drum **10**) is slightly smaller than the size in the direction of width of the support member **28** (size in the direction of center axis of the rotary drum **10**), and the first leg **46** of the blade support member **44** is located between the fastening screws **40** and **42** for fastening the support member **28**.

Described below with reference to FIGS. **1** and **2** together with FIG. **3** is the manner of mounting the blade-holding member **44** on the support member **28**. A threaded hole **50** is formed in the main portion **30** of the support member **28** at an intermediate portion in the direction of center axis of the rotary drum **10**, and a circular opening **52** is formed in the first leg **46** of the blade-holding member **44** at an intermediate portion in the direction of center axis of the rotary drum **10**. An annular shim **54** having a circular opening **56** is interposed between the main portion **30** of the support member **28** and the first leg **46** of the blade-holding member **44**. A mounting bolt **58** is screwed into the threaded hole **50** formed in the main portion **30** of the support member **28** passing through the circular opening **52** formed in the first leg **46** of the blade-holding member **44** and through the circular opening **56** of the annular shim **54**. The mounting bolt **58** has a head portion **60**, a threaded shaft portion **62** and a support shaft portion **64** positioned therebetween. The inner diameter D**1** of the circular openings **52** and **56** is smaller than the outer diameter of the head portion **60** of the mounting bolt **58**, but is slightly larger than the outer diameter D**2** of the support shaft portion **64** by, for example, about 0.05 mm. Furthermore, the length L**1** of the support shaft portion **64** of the mounting bolt **58** in the direction of axis is slightly larger, by, for example, about 0.1 to 0.2 mm, than the size L**2** which consists of the thickness of the first leg **46** of the blade-holding member **44** and the thickness of the annular shim **54**. Therefore, the blade-holding member **44** is allowed to swing on the center axis **66** of the mounting bolt **58** as a swing center axis. The center axis **66** of the mounting bolt **58**, i.e., the swing center axis of the blade-holding member **44** extends in a plane which is substantially perpendicular to the center axis **13** of the rotary drum **10**.

With reference to FIGS. **1** and **2**, a cleaning blade **68** that extends in the direction of center axis of the rotary drum **10** (in the direction perpendicularly to the surface of the paper in FIG. **2**) is held on the outer surface of the second leg **48** (right surface in FIG. **2**) of the blade-holding member **44**. The cleaning blade **68** is made of a synthetic rubber such as an urethane rubber having a thickness of about 2 mm, and is attached at its base end, i.e., at its upper end to the outer surface of the second leg **48** of the blade-holding member **44** via a suitable adhesive agent or a double-sided adhesive tape. The cleaning blade **68** downwardly protrudes beyond the second leg **48** of the blade-holding member **44**, and is pushed at its front end onto the peripheral surface of the rotary drum **10**. The cleaning blade **68** is disposed at a counter position, and an acute angle a of from about 10 to about 30 degrees is defined between the cleaning blade **68** and the tangential line **70** of the rotary drum **10** at a portion where the front end of the cleaning blade **68** comes into contact with the peripheral surface of the rotary drum **10**, on the downstream side in a direction in which the rotary drum **10** rotates. As described above, the blade-holding member **44** swings on a swing axis (i.e., center axis **66**) that extends in a plane which is substantially perpendicular to the center axis **13** of the rotary drum **10** and, hence, the cleaning blade **68** held by the blade-holding member **44** swings on the swing axis (i.e., center axis **66**) that extends in a plane substantially perpendicularly to the center axis **13** of the rotary drum **10**. Accordingly, the cleaning blade **68** swings, as required, on the swing axis and is automatically set to extend in parallel with the center axis **13** of the rotary drum **10** with sufficient precision.

In the illustrated cleaning means **12** are further disposed a sealing means **72**, a toner-recovering means **74** and a toner conveyer means **76**. The sealing means **72** can be made of a flexible sheet member such as polyethylene terephthalate sheet that extends in the direction of center axis of the rotary drum **10**. An upwardly protruding auxiliary wall **78** is formed at the free side edge (right side edge in FIG. **2**) of the

bottom wall **24** of the unit frame **4**, and the lower end of the sheet member constituting the sealing means **72** is attached to the outer surface of the auxiliary wall **78**. The upper end of the sheet member constituting the sealing means **72** is brought into intimate contact with the peripheral surface of the rotary drum **10**. The toner-recovering means **74** includes a rotary shaft **80** which is rotatably mounted between the front end wall **6** and the rear end wall **8** of the unit frame **4**, and a recovery roller **82** fitted onto the rotary shaft **80**. The recovery roller **82** can be made of a sponge. The toner-recovering means **74** is further provided with a scraping member **84**. The scraping member **84** which can be made of a suitable plastic sheet protrudes toward the recovery roller **82** from its base end attached to a protruded wall **86** formed on the bottom wall **24**, and its front edge is brought into contact with the recovery roller **82**. The toner conveyer means **76** includes a rotary shaft **88** which is rotatably mounted between the front end wall **6** and the rear end wall **8** of the unit frame **4**, and spiral vanes **90** disposed on the outer peripheral surface of the rotary shaft **88**. The rotary shaft **80** of the toner-recovering means **74** and the rotary shaft **88** of the toner conveyer means **76** rearwardly protrude penetrating through the rear end wall **8** of the unit frame **4**, and are coupled to the above-mentioned input gear (not shown) fitted to the rear end of the support shaft of the rotary drum **10** via transmission gears (not shown). As the rotary drum **10** is rotated in the clockwise direction in FIG. **2**, the recovery roller **82** is rotated in the counterclockwise direction in FIG. **2**, and the spiral vanes **90** are rotated in the counterclockwise direction, too, in FIG. **2**. Moreover, as schematically shown in FIG. **1**, a toner-discharge cylinder **92** forwardly protruded is formed on the front end wall **6** of the unit frame **4** in relation to the spiral vanes **90**.

The description is further continued with reference to FIGS. **1** and **2**. In the image-forming machine constituted according to the present invention, it is important that the cleaning means **12** is provided with a pair of restriction members **94***a* and **94***b*. The restriction members **94***a* and **94***b* have flat base portions **96***a* and **96***b*, connection portions **98***a* and **98***b* that extend nearly vertically relative to the base portions **96***a* and **96***b*, and restriction portions **100***a* and **100***b* that extend substantially in parallel with the base portions **96***a* and **96***b*. The restriction members **94***a* and **94***b* can be made of a steel plate having a thickness of about 1.2 mm. As will be clearly understood from FIG. **1**, the restriction members **94***a* and **94***b* are mounted on both end portions of the support member **28**. In further detail, the restriction member **94***a* is positioned on the front end portion of main portion **30** of the support member **28**, and is fastened onto the support member **28** by screwing a fastening screw **102***a* into the support member **28** passing through a hole (not shown) formed in the base portion **96***a* thereof, and the restriction member **94***b* is positioned on the rear end portion of main portion **30** of the support member **28**, and is fastened onto the support member **28** by screwing a fastening screw **102***b* into the support member **28** passing through a hole (not shown) formed in the base portion **96***b* thereof. The restriction portion **100***a* of the restriction member **94***a* is positioned being opposed, while maintaining a very small gap x, to the upper surface of the front end of the first leg **46** of the blade-holding member **44**, and the restriction portion **100***b* of the restriction member **94***b* is positioned being opposed, maintaining a very small gap x, to the upper surface of the rear end of the first leg **46** of the blade-holding member **4**. It is desired that the above-mentioned very small gap x is from 0.2 to 0.4 mm (i.e., 0.2 mm$\leqq$x$\leqq$ 0.4 mm). When the very small gap x is set to be too small, the blade-holding member **44** may be hindered from swinging on the center axis **66** of the mounting bolt **58** due to tolerance in the production or in the mounting. When the above-mentioned very small gap x becomes too great, it becomes difficult to restrict displacement at both ends of the blade-holding member **44** to a sufficiently small value as will become obvious from the description mentioned later.

Briefly described below is the function of the above-mentioned cleaning means **12**. In the cleaning zone **20**, the front end of the cleaning blade **68** is pushed onto the peripheral surface of the rotary drum **10** that rotates in the clockwise direction in FIG. **2**, and the residual toner falls down from the peripheral surface of the rotary drum **10** due to the action of the cleaning blade **68**. The toner that fell is leftwardly, in FIG. **2**, carried by the peripheral surface of the recovery roller **82** that rotates counterclockwise in FIG. **2**, scraped off the peripheral surface of the recovery roller **82** by the action of the scraping member **84**, and is guided onto the spiral vanes **90**. Then, by the action of the spiral vanes **90** that are rotating in the counterclockwise direction in FIG. **2**, the toner is conveyed to a front portion of the cleaning chamber **26**. The toner conveyed to the front portion of the cleaning chamber **26** is discharged from the cleaning chamber **26** through the toner-discharge cylinder **92** formed on the front end wall **6** of the unit frame **4**. The toner discharged from the cleaning chamber **26** is recovered in a suitable container (not shown) and is discarded or is used again being returned back to the developing means (not shown).

As will be easily comprehended with reference to FIG. **2**, furthermore, the cleaning blade **68** is disposed at a so-called counter position with respect to the rotary drum **10** and, hence, a considerably large upwardly directed force is given to the cleaning blade **68** and to the blade-holding member **44** that is holding the cleaning blade **68** by the rotary drum **10** which rotates in the clockwise direction in FIG. **2**. As described with reference to FIG. **3**, the length L**1** in the axial direction of the support shaft **64** of the mounting bolt **58** mounting the blade-holding member **44** on the support member **28** is greater, by a small amount which may be from about 0.1 to about 0.2 mm, than the size L**2** which consists of the thickness of the first leg **46** of the blade-holding member **44** and the thickness of the annular shim **54**. Due to the force exerted from the rotary drum **10** to the cleaning blade **68**, therefore, the cleaning blade **68** and the blade-holding member **44** as a whole are upwardly moved by the above small amount. Moreover, the blade-holding member **44** is coupled only at its intermediate portion in the direction of center axis of the rotary drum **10** to the support member **28** via the mounting bolt **58**, and extends in a so-called cantilevered manner forwardly and rearwardly from the intermediate portion. Therefore, the blade-holding member **44** is elastically deformed to some extent, and the front end and the rear end thereof are upwardly displaced. As the blade-holding member **44** is so elastically deformed, the front end and the rear end of the blade-holding member **44** come into contact with the restriction portions **100***a* and **100***b* of the restriction members **94***a* and **94***b*. Thus, the rigidity of the blade-holding member **44** as well as the rigidity of the restriction members **94***a* and **94***b* resist against resilient deformation of the blade-holding member **44**. The so-called cantilevered length of the restriction portions **100***a* and **100***b* of the restriction members **94***a* and **94***b* are relatively short and, hence, the restriction portions **100***a* and **100***b* of the restriction members **94***a* and **94***b* exhibit sufficiently large resistance against the above-mentioned resilient deformation of the blade-holding member **44**. Accordingly, as the front end and the rear end of the blade-holding

member **44** come into contact with the limiting portions **100***a* and **100***b* of the restriction members **94***a* and **94***b*, the blade-holding member **44** is effectively prevented from being further resiliently deformed, and, hence, the front end and rear end of the blade-holding member **44** are effectively prevented from being further upwardly displaced, i.e., the font end and rear end of the cleaning blade **68** are effectively prevented from being further upwardly displaced. Thus, both ends of the cleaning blade **68** are prevented from excessively displaced upwards, and cleaning performance is reliably prevented from being deteriorated since the pushing force of the cleaning blade **68** onto the peripheral surface of the rotary drum **10** is not so much decreased at both ends of the cleaning blade **68**.

As the rotary drum **10** is clockwisely rotated in FIG. **2**, as described above, the cleaning blade **68** and the blade-holding member **44** as a whole are upwardly moved by a small amount and, then, the blade-holding member **44** is resiliently deformed to some extent, so that the front end and the rear end thereof are upwardly displaced. As desired, the restriction members **94***a* and **94***b*, blade-holding member **44** and cleaning blade **68** can be designed in such sizes that the front end of the cleaning blade **68** pushes the peripheral surface of the rotary drum **10** sufficiently uniformly and with a given value over the whole width in the direction of center axis of the rotary drum **10** in a state where the cleaning blade **68** and the blade-holding member **44** are displaced as described above.

According to the above-mentioned cleaning means **12**, the support member **28** on which the blade-holding member **44** is mounted is fixingly secured to a predetermined position. As desired, however, the support member **28** may be mounted to swing on the swing axis which is substantially in parallel with the center axis **13** of the rotary drum **10** and a suitable positioning means such as an electromagnetic solenoid may be mounted on the support member **28**. In such a case, the support member **28** is selectively brought to an acting position to push the front end of the cleaning blade **68** onto the peripheral surface of the rotary drum **10** only when the peripheral surface of the rotary drum **10** needs be cleaned, and the support member **28** is brought to a non-acting position so that the front end of the cleaning blade **68** is separated away from the peripheral surface of the rotary drum **10** when the peripheral surface of the rotary drum **10** needs not be cleaned.

What we claim is:

1. An image-forming machine comprising a rotary drum which is rotatably mounted and has an electrostatic photosensitive material disposed on the peripheral surface thereof, and a cleaning means which removes the toner remaining on the peripheral surface of the rotary drum in a cleaning zone,

said cleaning means including a support member that extends in the direction of center axis of the rotary drum, a blade-holding member that is mounted on the upper surface of the support member and extends in the direction of center axis of the rotary drum, and a cleaning blade that is held by the blade-holding means and extends in the direction of center axis of the rotary drum,

said blade-holding member being mounted on the upper surface of the support member by coupling its intermediate portion in the direction of center axis to the upper surface of the support member to swing on the swing axis that extends in a plane which is substantially perpendicular to the center axis of the rotary drum,

the front end of the cleaning blade being pushed onto the peripheral surface of the rotary drum, and the tangential line of the rotary drum at a portion where the front end of the cleaning blade is contacted to the peripheral surface of the rotary drum and the cleaning blade defining an acute angle α on the downstream side as viewed in a direction in which the rotary drum rotates,

wherein restriction members are attached to the support member at both ends thereof in the direction of center axis, the restriction members having restriction portions opposed, while maintaining a very small gap x, to the upper surface of the blade-holding member in order to restrict both ends of the blade-holding member in the direction of center axis from being displaced in a direction to separate away from the upper surface of the support member.

2. An image-forming machine according to claim **1**, wherein said gap x is $0.2\ mm \leqq x \leqq 0.4\ mm$.

3. An image-forming machine according to claim **1**, wherein said blade-holding member is made of a steel plate having nearly an L-shape in cross section with a first leg and a second leg which are nearly perpendicular to each other, the first leg of the blade-holding member extends along the upper surface of the support member, the second leg of the blade-holding member protrudes from the first leg toward the rotary drum, and the cleaning blade is fixed at its base end to the second leg of the blade-holding member.

4. An image-forming machine according to claim **1**, wherein said support member is made of a steel plate having a channel shape in cross section, and the restriction members are made of a steel piece, respectively.

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